polymers or copolymers comprising cyclohexyl-3-ene moieties as ester groups. In view of the above amendment, Applicants respectfully traverse this rejection.

Claim 1, as amended, incorporates limitations formerly recited in claim 9 dependent thereon. Because the Examiner recognized that claim 9 was not anticipated by Tellier, the incorporation of these limitations renders claim 1 not anticipated by Tellier. Further, all pending claims dependent on claim 1 (e.g. claim 11) must therefore also be not anticipated by Tellier.

Claim 12, as amended, incorporates limitations formerly recited in claim 25 dependent thereon. Because the Examiner recognized that claim 25 was not anticipated by Tellier, the incorporation of these limitations renders claim 12 not anticipated by Tellier. Further, all pending claims dependent on claim 1 (e.g. claims 13, 23, and 24) must therefore also be not anticipated by Tellier.

4. Claim rejections under 35 U.S.C. §103

Claims 1-2, 4-13, 15-31, 33-90, and 92-98 are rejected under 35 U.S.C. §103(a) as being unpatentable over Ching et al., U.S. Pat. No. 5,627,239 ("Ching"). The Examiner alleges that Ching shows oxygen scavenging polymers containing cyclic allylic moieties. Applicants respectfully traverse this rejection.

Ching, at col. 6, lines 22-25, teaches the use of polymers comprising cyclic, linear, or branched allylic pendant moieties, which may be unsubstituted or substituted. However, Ching does not suggest that pendant cyclic groups are preferred or provide any advantage. Further, the specific pendant cyclic moieties recited in the present claims are not suggested by Ching.

The compounds, and compositions comprising the compounds, of the present invention have nonobvious advantages for oxygen scavenging that are not suggested by Ching. It is

generally held that the oxidation of a linear allylic moiety involves replacing an allylic -H with an -O-O-H group. The hydroperoxy function can cleave and form peroxy radical, which can then extract electrons from the main chain of the linear moiety to form an =O group. Extracting electrons from the main chain leads to fragmentation of the main chain. (See the attached Appendix B, "Polybutadiene Oxidation By-products"). Although some of the hydroperoxy oxygens will instead form -OH groups (or interchange between =O and -OH groups) which will not lead to fragmentation, the -OH group could be further oxidized to give =O; and also, there are enough =O groups to produce a measurable concentration of fragments which impart an off-taste or malodor to the polymer, a significant problem in food packaging (see the present specification at p. 11, lines 9-16). Ching neither teaches nor suggests a solution to this problem.

In contrast, the present inventors discovered that substantially no fragments were generated by the oxidation of pendant cyclic allylic moieties. The present inventors concluded that the formation of =O groups on these specific cyclic olefins does not lead to fragmentation. Instead, the =O groups enolize and aromatize to form aromatic rings (phenols and hydroquinones), which are known to be antioxidants and inhibit further degradation. (See the attached Appendix C, "EMCM Oxidation"). Because the prior Ching patent does not recognize this benefit or any other to the use of cyclic allylic pendant groups over non-cyclic allylic pendant groups, it cannot guide one of ordinary skill in the art to the invention as presently claimed.

For these reasons, Applicants believe the rejection is improper and should be withdrawn.

5. Conclusion

In summary, Applicants believe all pending claims 1, 4-8, 10-13, 15-24, 26-31, 33-90, and 92-98 are in condition for allowance. The Examiner is invited to contact the undersigned patent agent at (713) 934-4065 with any questions, comments or suggestions relating to the referenced patent application.

Respectfully submitted,

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February 12, 2001

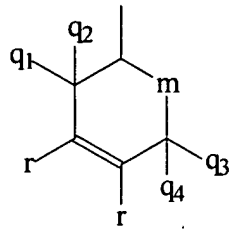
APPENDIX A

Pending claims, as amended

12 February 2001

WHAT IS CLAIMED IS:

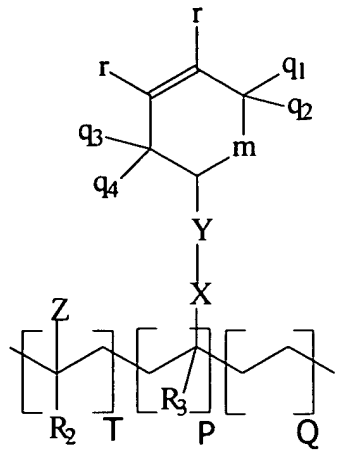
1. (Thrice Amended) A compound, comprising a polymeric backbone, cyclic olefinic pendent groups and linking groups linking the olefinic pendent groups to the polymeric backbone, [wherein the cyclic olefinic pendent groups have the structure (I):

(I) 

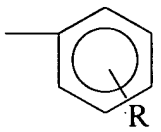
wherein q_1, q_2, q_3, q_4, and r are selected from the group consisting of hydrogen, methyl, and ethyl; and where m is $-(CH_2)_n-$ with n being an integer in the range from 0 to 4; and wherein, when r is hydrogen, at least one of q_1, q_2, q_3 and q_4 is hydrogen.]

~~wherein the polymeric backbone, linking groups and cyclic olefin pendent groups comprise repeating units, each unit having a structure (II) as follows:~~

(II)



wherein P+T+ Q is 100 mol % of the total composition; P is greater than 0 mol % of the total composition; Z is selected from the group consisting of an aryl group; $-(C=O)OR_1$; $-O(C=O)R_1$; and an alkyl aryl group:



where R_4 is selected from the group consisting of $-CH_3$, ethyl, and hydrogen; R_1 is selected from the group consisting of hydrogen, methyl, ethyl, $-C_3H_7$ and $-C_4H_9$; R_2 and R_3 are selected from the group consisting of hydrogen and methyl; X is selected from the group consisting of -O-, -NH-, -(C=O)O-, -(C=O)NH-, -(C=O)S-, -O(C=O)- and $-(CHR)_\lambda-$; λ is an integer in the range from 1 to 6; Y is $-(CHR)_n-$, where n is an integer in the range from 0 to 12, R being selected from the group consisting of hydrogen, methyl and ethyl; where q_1, q_2, q_3, q_4, and r are selected from the group consisting of hydrogen, methyl, and ethyl; and where m is $-(CH_2)_n-$ and where n is an integer in the range from 0 to 4; and wherein when r is hydrogen, at least one of q_1, q_2, q_3 and q_4 is hydrogen.

4. The compound of claim 1, wherein the polymeric backbone comprises monomers selected from the group consisting of ethylene and styrene.

5. The compound of claim 1, wherein the cyclic olefinic pendent groups are grafted onto the linking groups of the polymeric backbone by an esterification, transesterification, amidation or transamidation reaction.

6. The compound of claim 5, wherein the esterification, transesterification, amidation or transamidation reaction is a solution reaction or a reactive extrusion.

7. The compound of claim 5, wherein the esterification, transesterification, amidation or transamidation reaction is catalyzed by a catalyst selected from the group consisting of strong non-oxidizing acids, tertiary amines, Group I alkoxides, Group IVB alkoxides, and Group IVA organometallics.

8. The compound of claim 7, wherein the catalyst is selected from a group consisting of toluene sulfonic acid, sodium methoxide, tetrabutyl titanate, tetraisopropyl titanate, tetra-n-propyl-titanate, tetraethyl titanate, 2-hydroxy-pyridine and dibutyltin dilaurate.

10. (Amended) The compound of claim [9] 1, wherein the cyclic olefinic pendent groups are selected from the group consisting of cyclohexene-4-methylene radical, 1-methyl cyclohexene-4-methylene radical, 2-methyl cyclohexene-4-methylene radical, 5-methyl cyclohexene-4-methylene radical, 1,2-dimethyl cyclohexene-4-methylene radical, 1,5-dimethyl cyclohexene-4-methylene radical, 2,5-dimethyl cyclohexene-4-methylene radical, 1,2,5-trimethyl cyclohexene-4-methylene radical, cyclohexene-4-ethylene radical, 1-methyl cyclohexene-4-ethylene radical, 2-methyl cyclohexene-4-ethylene radical, 5-methyl cyclohexene-4-ethylene radical, 1,2-dimethyl cyclohexene-4-ethylene radical, 1,5-dimethyl cyclohexene-4-ethylene radical, 2,5-dimethyl cyclohexene-4-ethylene radical, 1,2,5-trimethyl cyclohexene-4-ethylene radical, cyclohexene-4-propylene radical, 1-methyl cyclohexene-4-propylene radical, 2-methyl cyclohexene-4-propylene radical, 5-methyl cyclohexene-4-propylene radical, 1,2-dimethyl cyclohexene-4-propylene radical, 1,5-dimethyl cyclohexene-4-propylene radical, 2,5-dimethyl cyclohexene-4-propylene radical, 1,2,5-trimethyl cyclohexene-4-propylene radical, cyclopentene-4-methylene radical, 1-methyl cyclopentene-4-methylene radical, 3-methyl

cyclopentene-4-methylene radical, 1,2-dimethyl cyclopentene-4-methylene radical, 3,5-dimethyl cyclopentene-4-methylene radical, 1,3-dimethyl cyclopentene-4-methylene radical, 2,3-dimethyl cyclopentene-4-methylene radical, 1,2,3-trimethyl cyclopentene-4-methylene radical, 1,2,3,5-tetramethyl cyclopentene-4-methylene radical, cyclopentene-4-ethylene radical, 1-methyl cyclopentene-4-ethylene radical, 3-methyl cyclopentene-4-ethylene radical, 1,2-dimethyl cyclopentene-4-ethylene radical, 3,5-dimethyl cyclopentene-4-ethylene radical, 1,3-dimethyl cyclopentene-4-ethylene radical, 2,3-dimethyl cyclopentene-4-ethylene radical, 1,2,3-trimethyl cyclopentene-4-ethylene radical, 1,2,3,5-tetramethyl cyclopentene-4-ethylene radical, cyclopentene-4-propylene radical, 1-methyl cyclopentene-4-propylene radical, 3-methyl cyclopentene-4-propylene radical, 1,2-dimethyl cyclopentene-4-propylene radical, 3,5-dimethyl cyclopentene-4-propylene radical, 1,3-dimethyl cyclopentene-4-propylene radical, 2,3-dimethyl cyclopentene-4-propylene radical, 1,2,3-trimethyl cyclopentene-4-propylene radical, and 1,2,3,5-tetramethyl cyclopentene-4-propylene radical.

11. (Amended) The compound of claim [9] 1, wherein the [composition] compound is an ethylene/methyl acrylate/cyclohexenyl methyl acrylate terpolymer[, a cyclohexenyl methyl acrylate/ethylene copolymer, a cyclohexenyl methyl methacrylate/styrene copolymer, a cyclohexenyl methyl acrylate homopolymer or a methyl acrylate/cyclohexenyl methyl acrylate copolymer].

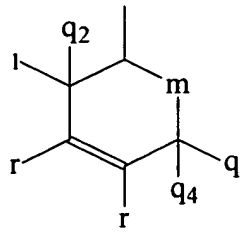
12. (Twice Amended) An oxygen scavenging composition, comprising a compound comprising a polymeric backbone, cyclic olefinic pendent groups, and linking groups linking the olefinic pendent groups to the polymeric backbone; and

a transition metal catalyst,

wherein the transition metal catalyst is a metal salt, and

wherein the cyclic olefinic pendent groups have the structure (I):

(I)



wherein q_1, q_2, q_3, q_4, and r are selected from the group consisting of hydrogen, methyl, and ethyl; and where m is $-(CH_2)_n-$ with n being an integer in the range from 0 to 4; and wherein, when r is hydrogen, at least one of q_1, q_2, q_3 and q_4 is hydrogen.

13. A composition according to claim 12, wherein the polymeric backbone is ethylenic and the linking groups are selected from the group consisting of:

$-O-(CHR)_n-$; $-(C=O)-O-(CHR)_n-$; $-NH-(CHR)_n-$; $-O-(C=O)-(CHR)_n-$;

$-(C=O)-NH-(-CHR)_n-$; and $-(C=O)-O-CHOH-CH_2-O-$;

wherein R is hydrogen or an alkyl group selected from the group consisting of methyl, ethyl, propyl and butyl groups and where n is an integer in the range from 1 to 12.

15. The composition of claim 12, wherein the polymeric backbone comprises monomers selected from the group consisting of ethylene and styrene.

16. The composition of claim 12, wherein the cyclic olefinic pendent groups are grafted onto the linking groups of the polymeric backbone by a esterification, transesterification, amidation or transamidation reaction.

17. The composition of claim 16, wherein the esterification, transesterification, amidation or transamidation reaction is a solution reaction or a reactive extrusion.

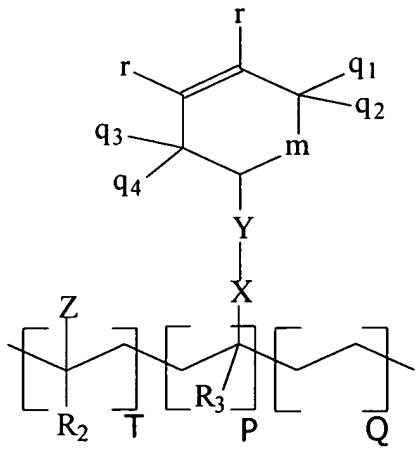
18. The composition of claim 16, wherein the esterification, transesterification, amidation or transamidation reaction is catalyzed by a catalyst selected from the group

consisting of strong non-oxidizing acids, tertiary amines, Group I alkoxides, Group IVB alkoxides, and Group IVA organometallics.

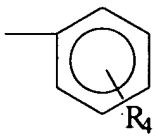
19. The composition of claim 18, wherein the catalyst is selected from a group consisting of toluene sulfonic acid, sodium methoxide, tetrabutyl titanate, tetraisopropyl titanate, tetra-n-propyl-titanate, tetraethyl titanate, 2-hydroxy-pyridine and dibutyltin dilaurate.

20. The composition of claim 12, wherein the polymeric backbone, linking groups and cyclic olefin pendent groups comprise repeating units, each unit having a structure (II) as follows:

(II)



wherein P + T + Q is 100 mol % of the total composition; P is greater than 0 mol % of the total composition; Z is selected from the group consisting of an aryl group; -(C=O)OR_1; -O(C=O)R_1; and an alkyl aryl group:



where R_4 is selected from the group consisting of $-CH_3$, ethyl, and hydrogen; R_1 is selected from the group consisting of hydrogen, methyl, ethyl, $-C_3H_7$ and $-C_4H_9$; R_2 and R_3 are selected from the group consisting of hydrogen and methyl; X is selected from

the group consisting of -O-, -NH-, -(C=O)O-, -(C=O)NH-, -(C=O)S-, -O(C=O)- and $-(CHR)_\lambda-$; λ is an integer in the range from 1 to 6; Y is $-(CHR)_n-$, where n is an integer in the range from 0 to 12, R being selected from the group consisting of hydrogen, methyl and ethyl; where q_1, q_2, q_3, q_4, and r are selected from the group consisting of hydrogen, methyl, and ethyl; and where m is $-(CH_2)_n-$ and where n is an integer in the range from 0 to 4; and wherein when r is hydrogen, at least one of q_1, q_2, q_3 and q_4 is hydrogen.

21. The composition of claim 20, wherein the cyclic olefinic pendent groups are selected from the group consisting of cyclohexene-4-methylene radical, 1-methyl cyclohexene-4-methylene radical, 2-methyl cyclohexene-4-methylene radical, 5-methyl cyclohexene-4-methylene radical, 1,2-dimethyl cyclohexene-4-methylene radical, 1,5-dimethyl cyclohexene-4-methylene radical, 2,5-dimethyl cyclohexene-4-methylene radical, 1,2,5-trimethyl cyclohexene-4-methylene radical, cyclohexene-4-ethylene radical, 1-methyl cyclohexene-4-ethylene radical, 2-methyl cyclohexene-4-ethylene radical, 5-methyl cyclohexene-4-ethylene radical, 1,2-dimethyl cyclohexene-4-ethylene radical, 1,5-dimethyl cyclohexene-4-ethylene radical, 2,5-dimethyl cyclohexene-4-ethylene radical, 1,2,5-trimethyl cyclohexene-4-ethylene radical, cyclohexene-4-propylene radical, 1-methyl cyclohexene-4-propylene radical, 2-methyl cyclohexene-4-propylene radical, 5-methyl cyclohexene-4-propylene radical, 1,2-dimethyl cyclohexene-4-propylene radical, 1,5-dimethyl cyclohexene-4-propylene radical, 2,5-dimethyl cyclohexene-4-propylene radical, 1,2,5-trimethyl cyclohexene-4-propylene radical, cyclopentene-4-methylene radical, 1-methyl cyclopentene-4-methylene radical, 3-methyl cyclopentene-4-methylene radical, 1,2-dimethyl cyclopentene-4-methylene radical, 3,5-dimethyl cyclopentene-4-methylene radical, 1,3-dimethyl cyclopentene-4-methylene radical, 2,3-dimethyl cyclopentene-4-methylene radical, 1,2,3-trimethyl cyclopentene-4-methylene radical, 1,2,3,5-tetramethyl cyclopentene-4-methylene radical, cyclopentene-4-ethylene radical, 1-methyl cyclopentene-4-ethylene radical, 3-methyl cyclopentene-4-ethylene radical, 1,2-dimethyl cyclopentene-4-ethylene radical, 3,5-dimethyl cyclopentene-4-ethylene radical, 1,3-dimethyl cyclopentene-4-ethylene radical, 2,3-dimethyl cyclopentene-4-ethylene radical, 1,2,3-trimethyl cyclopentene-4-ethylene radical, 1,2,3,5-tetramethyl cyclopentene-4-ethylene radical, cyclopentene-4-propylene

radical, 1-methyl cyclopentene-4-propylene radical, 3-methyl cyclopentene-4-propylene radical, 1,2-dimethyl cyclopentene-4-propylene radical, 3,5-dimethyl cyclopentene-4-propylene radical, 1,3-dimethyl cyclopentene-4-propylene radical, 2,3-dimethyl cyclopentene-4-propylene radical, 1,2,3-trimethyl cyclopentene-4-propylene radical, and 1,2,3,5-tetramethyl cyclopentene-4-propylene radical.

22. (Amended) The composition of claim 20, wherein the [composition] compound is an ethylene/methyl acrylate/cyclohexenyl methyl acrylate terpolymer, a cyclohexenyl methyl acrylate/ethylene copolymer, a cyclohexenyl methyl methacrylate/styrene copolymer, a cyclohexenyl methyl acrylate homopolymer or a methyl acrylate/cyclohexenyl methyl acrylate copolymer.

23. The composition of claim 12, wherein odor and taste characteristics of products packaged with material comprised of the composition are not adulterated as a result of oxidation of the composition.

24. The composition of claim 12, wherein there is no significant fragmentation of the olefinic pendent groups and linking groups from the polymeric backbone as a result of oxidation of the composition.

26. (Amended) The composition of claim [25] 12, wherein the metal in the metal salt is cobalt.

27. (Amended) The composition according to claim [25] 12, wherein the metal salt is selected from the group consisting of cobalt neodecanoate, cobalt 2-ethylhexanoate, cobalt oleate and cobalt stearate.

28. The composition of claim 12, further comprising at least one triggering material to enhance initiation of oxygen scavenging.

29. The composition of claim 28, wherein the triggering material is a photo initiator.

30. An article of manufacture suitable as a container, the container inhibiting oxidation of contents of the container by removing oxygen from the container and by inhibiting ingress of oxygen into the container from outside the container,

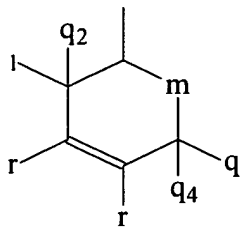
wherein the article comprises an oxygen scavenging composition which comprises

a compound comprising a polymeric backbone, cyclic olefinic pendent groups, and linking groups linking the olefinic pendent groups to the backbone, and

a transition metal catalyst,

wherein the cyclic olefinic pendent groups have the structure (I):

(I)



where q_1, q_2, q_3, q_4, and r are selected from the group consisting of hydrogen, methyl, and ethyl; and where m is $-(CH_2)_n-$ with n being an integer in the range from 0 to 4; and wherein, when r is hydrogen, at least one of q_1, q_2, q_3 and q_4 is hydrogen.

31. The article of manufacture of claim 30, wherein the polymeric backbone is ethylenic and the linking groups are selected from the group consisting of:

$-O-(CHR)_n-$; $-(C=O)-O-(CHR)_n-$; $-NH-(CHR)_n-$; $-O-(C=O)-(CHR)_n-$;

$-(C=O)-NH-(-CHR)_n-$; and $-(C=O)-O-CHOH-CH_2-O-$;

wherein R is hydrogen or an alkyl group selected from the group consisting of methyl, ethyl, propyl and butyl groups and where n is an integer in the range from 1 to 12.

33. The article of manufacture of claim 30, wherein the polymeric backbone comprises monomers selected from the group consisting of ethylene and styrene.

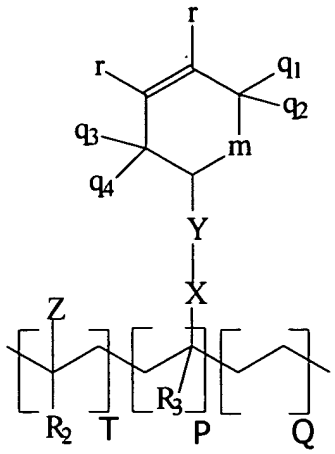
34. The article of manufacture of claim 30, wherein the cyclic olefinic pendent groups are grafted onto the linking groups of the polymeric backbone by a esterification, transesterification, amidation or transamidation reaction.

35. The article of manufacture of claim 34, wherein the esterification, transesterification, amidation or transamidation reaction is a solution reaction or a reactive extrusion.

36. The article of manufacture of claim 34, wherein the esterification, transesterification, amidation or transamidation reaction is catalyzed by a catalyst selected from the group consisting of strong non-oxidizing acids, tertiary amines, Group I alkoxides, Group IVB alkoxides, and Group IVA organometallics.

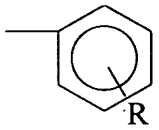
37. The article of manufacture of claim 36, wherein the catalyst is selected from the group consisting of toluene sulfonic acid, sodium methoxide, tetrabutyl titanate, tetraisopropyl titanate, tetra-n-propyl-titanate, tetraethyl titanate, 2-hydroxy-pyridine and dibutyltin dilaurate.

38. The article of manufacture of claim 30, wherein the backbone, linking groups and cyclic olefin pendent groups comprise repeating units, each unit having a structure (II) as follows:



(II)

wherein P+T + Q is 100 mol % of the total composition; P is greater than 0 mol % of the total composition; Z is selected from the group consisting of an aryl group, $-(C=O)OR_1$, $-O(C=O)R_1$ and an alkyl aryl group:



where R_4 is selected from the group consisting of $-CH_3$, ethyl, and hydrogen; R_1 is selected from the group consisting of hydrogen, methyl, ethyl, $-C_3H_7$ and $-C_4H_9$; R_2 and R_3 are selected from the group consisting of hydrogen and CH_3; X is selected from the group consisting of O-, -NH-, -(C=O)O-, -(C=O)NH-, -(C=O)S-, -O(C=O)- and $-(CHR)_\lambda-$; λ is an integer selected from the group consisting of 1, 2, 3, 4, 5 and 6; Y is $-(CHR)_n-$, where n is an integer in the range from 0 to 12 and R is selected from the group consisting of hydrogen, methyl and C_2H_5; and where q_1, q_2, q_3, q_4, and r are selected from the group consisting of hydrogen, methyl, and ethyl; and where m is $-(CH_2)_n-$ and where n is an integer in the range of from 0 to 4; and wherein when r is hydrogen, at least one of q_1, q_2, q_3, and q_4 is hydrogen.

39. The article of manufacture of claim 30, wherein the cyclic olefinic pendent groups are selected from the group consisting of cyclohexene-4-methylene radical, 1-methyl cyclohexene-4-methylene radical, 2-methyl cyclohexene-4-methylene radical, 5-methyl

cyclohexene-4-methylene radical, 1,2-dimethyl cyclohexene-4-methylene radical, 1,5-dimethyl cyclohexene-4-methylene radical, 2,5-dimethyl cyclohexene-4-methylene radical, 1,2,5-trimethyl cyclohexene-4-methylene radical, cyclohexene-4-ethylene radical, 1-methyl cyclohexene-4-ethylene radical, 2-methyl cyclohexene-4-ethylene radical, 5-methyl cyclohexene-4-ethylene radical, 1,2-dimethyl cyclohexene-4-ethylene radical, 1,5-dimethyl cyclohexene-4-ethylene radical, 2,5-dimethyl cyclohexene-4-ethylene radical, 1,2,5-trimethyl cyclohexene-4-ethylene radical, cyclohexene-4-propylene radical, 1-methyl cyclohexene-4-propylene radical, 2-methyl cyclohexene-4-propylene radical, 5-methyl cyclohexene-4-propylene radical, 1,2-dimethyl cyclohexene-4-propylene radical, 1,5-dimethyl cyclohexene-4-propylene radical, 2,5-dimethyl cyclohexene-4-propylene radical, 1,2,5-trimethyl cyclohexene-4-propylene radical, cyclopentene-4-methylene radical, 1-methyl cyclopentene-4-methylene radical, 3-methyl cyclopentene-4-methylene radical, 1,2-dimethyl cyclopentene-4-methylene radical, 3,5-dimethyl cyclopentene-4-methylene radical, 1,3-dimethyl cyclopentene-4-methylene radical, 2,3-dimethyl cyclopentene-4-methylene radical, 1,2,3-trimethyl cyclopentene-4-methylene radical, 1,2,3,5-tetramethyl cyclopentene-4-methylene radical, cyclopentene-4-ethylene radical, 1-methyl cyclopentene-4-ethylene radical, 3-methyl cyclopentene-4-ethylene radical, 1,2-dimethyl cyclopentene-4-ethylene radical, 3,5-dimethyl cyclopentene-4-ethylene radical, 1,3-dimethyl cyclopentene-4-ethylene radical, 2,3-dimethyl cyclopentene-4-ethylene radical, 1,2,3-trimethyl cyclopentene-4-ethylene radical, 1,2,3,5-tetramethyl cyclopentene-4-ethylene radical, cyclopentene-4-propylene radical, 1-methyl cyclopentene-4-propylene radical, 3-methyl cyclopentene-4-propylene radical, 1,2-dimethyl cyclopentene-4-propylene radical, 3,5-dimethyl cyclopentene-4-propylene radical, 1,3-dimethyl cyclopentene-4-propylene radical, 2,3-dimethyl cyclopentene-4-propylene radical, 1,2,3-trimethyl cyclopentene-4-propylene radical, and 1,2,3,5-tetramethyl cyclopentene-4-propylene radical.

40. (Amended) The article of manufacture of claim 30, wherein the [composition] <u>compound</u> is an ethylene/methyl acrylate/cyclohexenyl methyl acrylate terpolymer, a cyclohexenyl methyl acrylate/ethylene copolymer, a cyclohexenyl methyl

methacrylate/styrene copolymer, a cyclohexenyl methyl acrylate homopolymer or a methyl acrylate/cyclohexenyl methyl acrylate copolymer.

41. The article of manufacture according to claim 30, wherein the transition metal catalyst is a metal salt.

42. The article of manufacture according to claim 41, wherein the metal in the metal salt is cobalt.

43. The article of manufacture of according to claim 41, wherein the metal salt is selected from the group consisting of cobalt neodecanoate, cobalt 2-ethylhexanoate, cobalt oleate and cobalt stearate.

44. The article of manufacture of claim 30, further comprising at least one triggering material to enhance initiation of oxygen scavenging.

45. The article of manufacture of claim 44, wherein the triggering material is a photoinitiator.

46. The article of manufacture of claim 30, wherein odor and taste characteristics of products packaged with material comprised of the composition are not adulterated as a result of oxidation of the composition.

47. The article of manufacture of claim 30, wherein there is no significant fragmentation of the olefinic pendent groups and linking groups from the polymeric backbone as a result of oxidation of the composition.

48. The article of manufacture of claim 30 wherein the article is a package.

49. The article of manufacture of claim 48, wherein the package comprises a flexible film having a thickness of at most 10 mil or a flexible sheet having a thickness of at least 10 mil.

50. The article of manufacture of claim 48, wherein the oxygen scavenging system of the package comprises at least one additional layer selected from among oxygen barrier layers, polymeric selective layers, and heat seal layers.

51. The article of manufacture of claim 48, wherein the article is a package with a food product located within the package.

52. The article of manufacture of claim 48, wherein the article is a package for packaging a cosmetic, chemical, electronic device, pesticide or a pharmaceutical composition.

53. A multi-layer film comprising the article of manufacture according to claim 30, and at least one additional functional layer.

54. The multi-layer film according to claim 53, wherein at least one additional layer is selected from among oxygen barrier layers, polymeric selective barrier layers, structural layers and heat seal layers.

55. The multi-layer film according to claim 53, wherein the at least one additional layer is an oxygen barrier layer.

56. The multi-layer film according to claim 55, further comprising at least one polymeric selective barrier layer.

57. The multi-layer film according to claim 55, further comprising at least one heat seal layer.

58. The multi-layer film according to claim 55, further comprising at least one structural layer.

59. The article of claim 30, wherein the article is a rigid container, sealing gasket, patch, container closure device, bottle cap, bottle cap insert or molded or thermoformed shape.

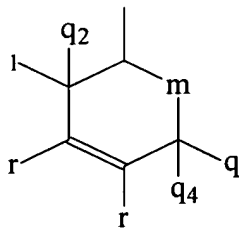
60. The article of claim 59, wherein the molded or thermoformed shape is a bottle or tray.

61. A layer suitable for scavenging oxygen comprising:

(a) a compound comprising a polymer backbone;

cyclic olefinic pendent groups, wherein the cyclic olefinic pendent groups have the structure (I):

(I)



where q_1, q_2, q_3, q_4, and r are selected from the group consisting of hydrogen, methyl, and ethyl; and where m is $-(CH_2)_n-$ with n being an integer in the range from 0 to 4; and wherein, when r is hydrogen, at least one of q_1, q_2, q_3 and q_4 is hydrogen;

linking groups linking the backbone with the pendent groups; and

(b) a transition metal catalyst.

62. The layer of claim 61, wherein odor and taste characteristics of products packaged with material comprised of the layer are not adulterated as a result of oxidation of the layer.

63. The layer of claim 61, wherein there is no significant fragmentation of the olefinic pendent groups and linking groups from the polymeric backbone as a result of oxidation of the layer.

64. A layer according to claim 61, wherein the transition metal catalyst is a metal salt.

65. A layer according to claim 64, wherein the transition metal in the metal salt is cobalt.

66. A layer according to claim 64, wherein the metal salt selected from the group consisting of cobalt neodecanoate, cobalt 2-ethylhexanoate, cobalt oleate and cobalt stearate.

67. A layer according to claim 61, wherein said layer in addition comprises polymeric diluent.

68. A layer according to claim 67, wherein said diluent is a thermoplastic polymer.

69. A layer according to claim 61, wherein said layer is adjacent to one or more additional layers.

70. A layer according to claim 69, wherein at least one additional layer is an oxygen barrier.

71. A layer according to claim 70, wherein said oxygen barrier comprises a member of the group consisting of poly(ethylene-vinyl alcohol), polyacrylonitrile, poly(vinyl

chloride), polyamides, poly(vinylidene dichloride), poly(ethylene terephthalate), silica, metal foil and metalized polymeric films.

72. A layer according to claim 69, wherein one or more of said additional layer or layers is coextruded with said layer.

73. A layer according to claim 69, wherein one or more of said additional layer or layers is laminated onto said layer.

74. A layer according to claim 69, wherein one or more of said additional layer or layers is coated onto said layer.

75. A layer according to claim 69, wherein said layer is flexible.

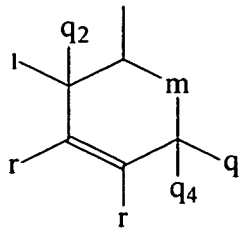
76. A layer according to claim 69, wherein said layer is transparent.

77. An article for packaging wherein the article comprises a layer according to claim 61.

78. A process of making a polymer material by a process selected from the group consisting of esterification, transesterification, amidation, transamidation and direct polymerization, wherein the polymer material comprises a polymer backbone, cyclic olefinic pendent groups, and linking groups linking the backbone with the pendent groups,

wherein the cyclic olefinic pendent groups have the structure (I):

(I)



where q_1, q_2, q_3, q_4, and r are selected from the group consisting of hydrogen, methyl, and ethyl; and where m is $-(CH_2)_n-$ with n being an integer in the range from 0 to 4; and wherein, when r is hydrogen, at least one of q_1, q_2, q_3 and q_4 is hydrogen.

79. The process of claim 78, wherein making the polymer material comprises the steps of:

(a) selecting polymers from the group consisting of styrene/maleic anhydride, ethylene/maleic anhydride, ethylene/acrylic acid, ethylene/methacrylic acid, acrylic acid, methacrylic acid, styrene/methacrylic acid, ethylene/methyl acrylate, ethylene/ethyl acrylate, ethylene/butyl acrylate, methyl methacrylate, methyl acrylate, and styrene/methyl methacrylate to form a mixture and combining the polymers with a esterifying/transesterifying compound selected from the group consisting of cyclohexene-4-methanol, 1-methyl cyclohexene-4-methanol, 2-methyl cyclohexene-4-methanol, 5-methyl cyclohexene-4-methanol, 1,2-dimethyl cyclohexene-4-methanol, 1,5-dimethyl cyclohexene-4-methanol, 2,5-dimethyl cyclohexene-4-methanol, 1,2,5-trimethyl cyclohexene-4-methanol, cyclohexene-4-ethanol, 1-methyl cyclohexene-4-ethanol, 2-methyl cyclohexene-4-ethanol, 5-methyl cyclohexene-4-ethanol, 1,2-dimethyl cyclohexene-4-ethanol, 1,5-dimethyl cyclohexene-4-ethanol, 2,5-dimethyl cyclohexene-4-ethanol, 1,2,5-trimethyl cyclohexene-4-ethanol, cyclohexene-4-propanol, 1-methyl cyclohexene-4-propanol, 2-methyl cyclohexene-4-propanol, 5-methyl cyclohexene-4-propanol, 1,2-dimethyl cyclohexene-4-propanol, 1,5-dimethyl cyclohexene-4-propanol, 2,5-dimethyl cyclohexene-4-propanol, 1,2,5-trimethyl cyclohexene-4-propanol, cyclopentene-4-methanol, 1-methyl cyclopentene-4-methanol, 3-methyl cyclopentene-4-methanol, 1,2-dimethyl cyclopentene-4-methanol, 3,5-dimethyl cyclopentene-4-methanol, 1,3-dimethyl cyclopentene-4-methanol, 2,3-dimethyl cyclopentene-4-

methanol, 1,2,3-trimethyl cyclopentene-4-methanol, 1,2,3,5-tetramethyl cyclopentene-4-methanol, cyclopentene-4-ethanol, 1-methyl cyclopentene-4-ethanol, 3-methyl cyclopentene-4-ethanol, 1,2-dimethyl cyclopentene-4-ethanol, 3,5-dimethyl cyclopentene-4-ethanol, 1,3-dimethyl cyclopentene-4-ethanol, 2,3-dimethyl cyclopentene-4-ethanol, 1,2,3-trimethyl cyclopentene-4-ethanol, 1,2,3,5-tetramethyl cyclopentene-4-ethanol, cyclopentene-4-propanol, 1-methyl cyclopentene-4-propanol, 3-methyl cyclopentene-4-propanol, 1,2-dimethyl cyclopentene-4-propanol, 3,5-dimethyl cyclopentene-4-propanol, 1,3-dimethyl cyclopentene-4-propanol, 2,3-dimethyl cyclopentene-4-propanol, 1,2,3-trimethyl cyclopentene-4-propanol, and 1,2,3,5-tetramethyl cyclopentene-4-propanol;

(b) heating the polymers and esterifying/transesterifying compounds selected in (a) to form a polymer melt;

(c) processing the melt in an extruder under esterification/transesterification conditions with esterification/transesterification catalysts and antioxidants protecting the melt from oxidation during extrusion, so that the polymer melt undergoes esterification of polymeric anhydrides with cyclic olefin pendent groups, esterification of polymeric acids with cyclic olefin pendent groups or exchange of alkyl groups of polymeric esters with cyclic olefin pendent groups; and

(d) removing volatile organic products and by-products from the melt.

80. The process of claim 78, wherein making the polymer material comprises the steps of:

(a) selecting polymers from the group consisting of styrene/maleic anhydride, ethylene/maleic anhydride, ethylene/acrylic acid, ethylene/methacrylic acid, acrylic acid, methacrylic acid, styrene/methacrylic acid, ethylene/methyl acrylate, ethylene/ethyl acrylate, ethylene/butyl acrylate, methyl methacrylate, methyl acrylate, and styrene/methyl methacrylate to form a mixture and combining the polymers with a amidizing/transamidizing compound selected from the group consisting of cyclohexene-4-methyl amine, 1-methyl cyclohexene-4-methyl amine, 2-methyl cyclohexene-4-methyl amine, 5-methyl cyclohexene-4-methyl amine, 1,2-dimethyl cyclohexene-4-methyl amine, 1,5-dimethyl cyclohexene-4-methyl amine, 2,5-dimethyl cyclohexene-4-methyl

amine, 1,2,5-trimethyl cyclohexene-4-methyl amine, cyclohexene-4-ethyl amine, 1-methyl cyclohexene-4-ethyl amine, 2-methyl cyclohexene-4-ethyl amine, 5-methyl cyclohexene-4-ethyl amine, 1,2-dimethyl cyclohexene-4-ethyl amine, 1,5-dimethyl cyclohexene-4-ethyl amine, 2,5-dimethyl cyclohexene-4-ethyl amine, 1,2,5-trimethyl cyclohexene-4-ethyl amine, cyclohexene-4-propyl amine, 1-methyl cyclohexene-4-propyl amine, 2-methyl cyclohexene-4-propyl amine, 5-methyl cyclohexene-4-propyl amine, 1,2-dimethyl cyclohexene-4-propyl amine, 1,5-dimethyl cyclohexene-4-propyl amine, 2,5-dimethyl cyclohexene-4-propyl amine, 1,2,5-trimethyl cyclohexene-4-propyl amine, cyclopentene-4-methyl amine, 1-methyl cyclopentene-4-methyl amine, 3-methyl cyclopentene-4-methyl amine, 1,2-dimethyl cyclopentene-4-methyl amine, 3,5-dimethyl cyclopentene-4-methyl amine, 1,3-dimethyl cyclopentene-4-methyl amine, 2,3-dimethyl cyclopentene-4-methyl amine, 1,2,3-trimethyl cyclopentene-4-methyl amine, 1,2,3,5-tetramethyl cyclopentene-4-methyl amine, cyclopentene-4-ethyl amine, 1-methyl cyclopentene-4-ethyl amine, 3-methyl cyclopentene-4-ethyl amine, 1,2-dimethyl cyclopentene-4-ethyl amine, 3,5-dimethyl cyclopentene-4-ethyl amine, 1,3-dimethyl cyclopentene-4-ethyl amine, 2,3-dimethyl cyclopentene-4-ethyl amine, 1,2,3-trimethyl cyclopentene-4-ethyl amine, 1,2,3,5-tetramethyl cyclopentene-4-ethyl amine, cyclopentene-4-propyl amine, 1-methyl cyclopentene-4-propyl amine, 3-methyl cyclopentene-4-propyl amine, 1,2-dimethyl cyclopentene-4-propyl amine, 3,5-dimethyl cyclopentene-4-propyl amine, 1,3-dimethyl cyclopentene-4-propyl amine, 2,3-dimethyl cyclopentene-4-propyl amine, 1,2,3-trimethyl cyclopentene-4-propyl amine, and 1,2,3,5-tetramethyl cyclopentene-4-propyl amine;

(b) heating the polymers and amidizing/transamidizing compounds selected in (a) to form a polymer melt;

(c) processing the melt in an extruder under amidation/transamidation conditions with amidation/transamidation catalysts and antioxidants protecting the melt from oxidation during extrusion, so that the polymer melt undergoes amidation of polymeric anhydrides with cyclic olefin pendent groups, amidation of polymeric acids with cyclic olefin pendent groups or exchange of alkyl groups of polymeric esters with cyclic olefin pendent groups; and

(d) removing volatile organic products and by-products from the melt.

81. The process of claim 78, wherein the making of the polymer material comprises the steps of:

(a) adding to an autoclave, ethylene and a vinyl monomer comprising a pendent cyclohexene;

(b) stirring the ethylene and the vinyl monomer in the autoclave to achieve a mixture;

(c) adding a polymerization initiator before, during or after the stirring step;

(d) polymerizing the mixture to achieve a polymer; and

(e) isolating and purifying the polymer.

82. The process of claim 81, wherein in step (a) an alpha-olefin is added to the autoclave along with the ethylene and the vinyl monomer and in step (b) the alpha-olefin is stirred with the ethylene and the vinyl monomer to achieve the mixture.

83. The process of claim 79, wherein the polymeric backbone is ethylenic and the linking groups are selected from the group consisting of:

$-O-(CHR)_n-$; $-(C=O)-O-(CHR)_n-$; $-NH-(CHR)_n-$;
$-O-(C=O)-(CHR)_n-$; $-(C=O)-NH-(-CHR)_n-$; and
$-(C=O)-O-CHOH-CH_2-O-$;

where R is hydrogen or an alkyl group selected from the group consisting of methyl, ethyl, propyl and butyl groups and where n is an integer in the range from 1 to 12.

84. The process of claim 80, wherein the polymeric backbone is ethylenic backbone and the linking group is:

$-(C=O)-NH-(CHR)_n$

where R is hydrogen or an alkyl group selected from the group consisting of methyl, ethyl, propyl and butyl groups and where n is an integer in the range from 1 to 12.

85. The process of claim 78, wherein the material is an oxygen scavenging composition further comprising a transition metal catalyst.

86. The process of claim 85, wherein the transition metal catalyst is a metal salt.

87. The process of claim 86, wherein the metal in the metal salt is cobalt.

88. The process according to claim 86, wherein the metal salt is selected from the group consisting of cobalt neodecanoate, cobalt 2-ethylhexanoate, cobalt oleate and cobalt stearate.

89. The process of claim 85, wherein the oxygen scavenging composition further comprises at least one triggering material to enhance initiation of oxygen scavenging.

90. The process of claim 89, wherein the triggering material is a photoinitiator.

92. The process of claim 78, wherein the functional groups with attached cyclic olefinic pendent groups are grafted onto the linking backbone by a esterification, transesterification, amidation or transamidation reaction.

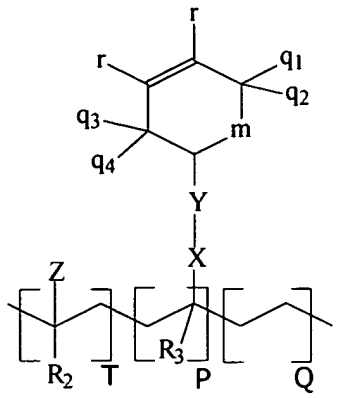
93. The process of claim 78, wherein the reaction is a solution reaction or a reactive extrusion.

94. The process of claim 78, wherein the esterification, transesterification, amidation or transamidation reaction is catalyzed by a catalyst selected from the group consisting of strong non-oxidizing acids, tertiary amines, Group I alkoxides, Group IVB alkoxides, Group IVA organometallics.

95. The process of claim 94, wherein the catalyst is selected from the group consisting of toluene sulfonic acid, sodium methoxide, tetrabutyl titanate, tetraisopropyl

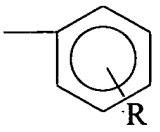
titanate, tetra-n-propyl-titanate, tetraethyl titanate, 2-hydroxy-pyridine and dibutyltin dilaurate.

96. The process of claim 78, wherein the backbone, linking groups and cyclic olefin pendent groups comprise repeating units, each unit having a structure (II) as follows:



(II)

wherein P + T + Q is 100 mol % of the total composition; P is greater than 0; Z is selected from the group consisting of an aryl group, -(C=O)OR_1, -O(C=O)R_1 and an alkyl aryl group:



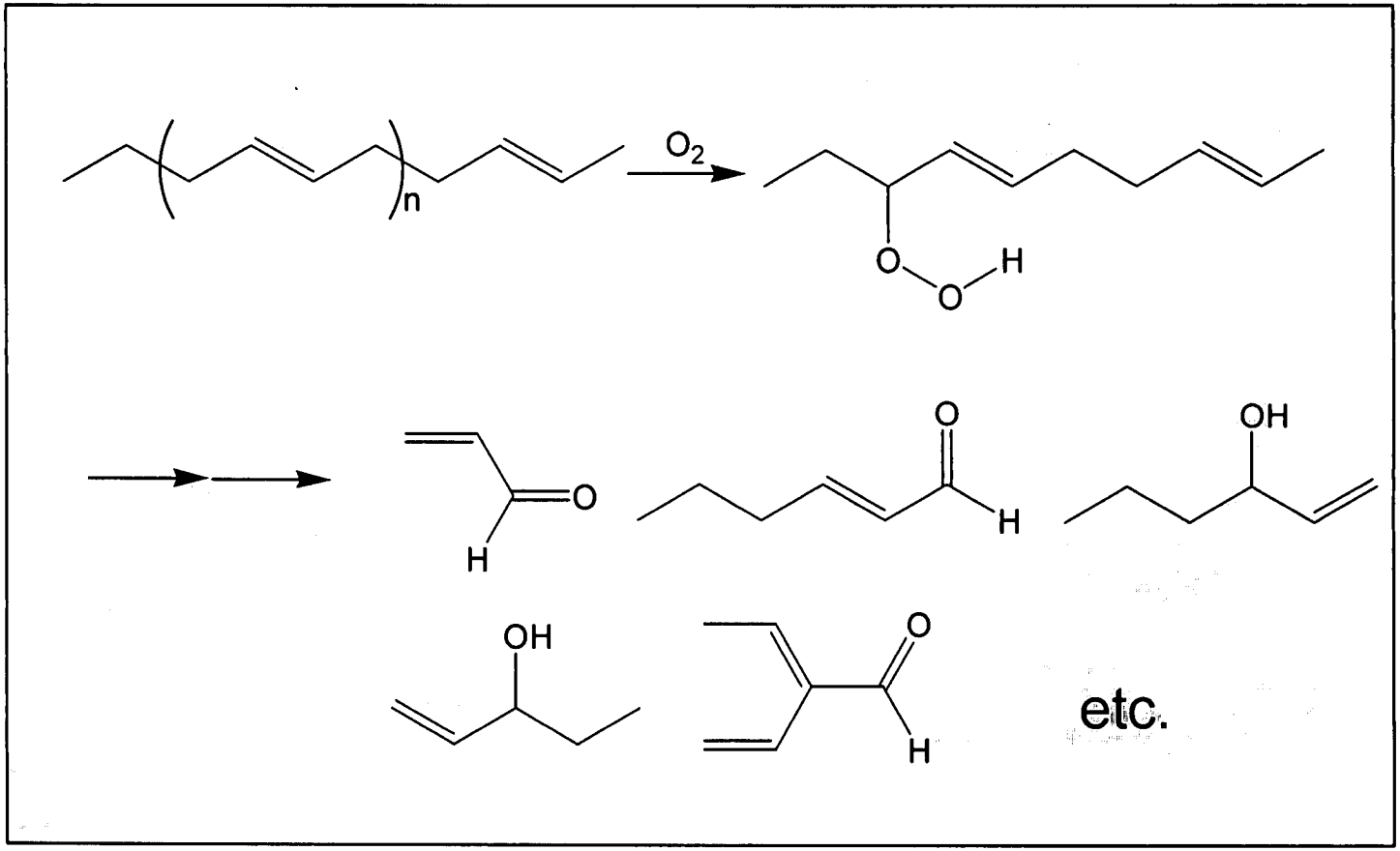
where R_4 is selected from the group consisting of hydrogen, methyl and ethyl; R_1 is selected from the group consisting of hydrogen, methyl, ethyl, -C_3H_5 and -C_4H_7; R_2 and R_3 is selected from the group consisting of hydrogen and CH_3; X is selected from the group consisting of O-, -NH-, -(C=O)O-, -(C=O)NH-, -(C=O)S-, -O(C=O)- and –$(CHR)_\lambda$-; λ is an integer selected from the group consisting of 1, 2, 3, 4, 5 and 6; Y is -$(CHR)_n$-, where n is an integer in the range from 0 to 12 where R is selected from the group consisting of hydrogen, methyl and ethyl; where q_1, q_2, q_3, q_4, and r are selected from the group consisting of hydrogen, methyl, and ethyl; and where m is -$(CH_2)_n$- and where n is an integer in the range of from 0 to 4; and wherein when r is hydrogen, at least one of q_1, q_2, q_3 and q_4 is hydrogen.

97. The process of claim 78, wherein the cyclic olefinic pendent groups are selected from the group consisting of cyclohexene-4-methylene radical, 1-methyl cyclohexene-4-methylene radical, 2-methyl cyclohexene-4-methylene radical, 5-methyl cyclohexene-4-methylene radical, 1,2-dimethyl cyclohexene-4-methylene radical, 1,5-dimethyl cyclohexene-4-methylene radical, 2,5-dimethyl cyclohexene-4-methylene radical, 1,2,5-trimethyl cyclohexene-4-methylene radical, cyclohexene-4-ethylene radical, 1-methyl cyclohexene-4-ethylene radical, 2-methyl cyclohexene-4-ethylene radical, 5-methyl cyclohexene-4-ethylene radical, 1,2-dimethyl cyclohexene-4-ethylene radical, 1,5-dimethyl cyclohexene-4-ethylene radical, 2,5-dimethyl cyclohexene-4-ethylene radical, 1,2,5-trimethyl cyclohexene-4-ethylene radical, cyclohexene-4-propylene radical, 1-methyl cyclohexene-4-propylene radical, 2-methyl cyclohexene-4-propylene radical, 5-methyl cyclohexene-4-propylene radical, 1,2-dimethyl cyclohexene-4-propylene radical, 1,5-dimethyl cyclohexene-4-propylene radical, 2,5-dimethyl cyclohexene-4-propylene radical, 1,2,5-trimethyl cyclohexene-4-propylene radical, cyclopentene-4-methylene radical, 1-methyl cyclopentene-4-methylene radical, 3-methyl cyclopentene-4-methylene radical, 1,2-dimethyl cyclopentene-4-methylene radical, 3,5-dimethyl cyclopentene-4-methylene radical, 1,3-dimethyl cyclopentene-4-methylene radical, 2,3-dimethyl cyclopentene-4-methylene radical, 1,2,3-trimethyl cyclopentene-4-methylene radical, 1,2,3,5-tetramethyl cyclopentene-4-methylene radical, cyclopentene-4-ethylene radical, 1-methyl cyclopentene-4-ethylene radical, 3-methyl cyclopentene-4-ethylene radical, 1,2-dimethyl cyclopentene-4-ethylene radical, 3,5-dimethyl cyclopentene-4-ethylene radical, 1,3-dimethyl cyclopentene-4-ethylene radical, 2,3-dimethyl cyclopentene-4-ethylene radical, 1,2,3-trimethyl cyclopentene-4-ethylene radical, 1,2,3,5-tetramethyl cyclopentene-4-ethylene radical, cyclopentene-4-propylene radical, 1-methyl cyclopentene-4-propylene radical, 3-methyl cyclopentene-4-propylene radical, 1,2-dimethyl cyclopentene-4-propylene radical, 3,5-dimethyl cyclopentene-4-propylene radical, 1,3-dimethyl cyclopentene-4-propylene radical, 2,3-dimethyl cyclopentene-4-propylene radical, 1,2,3-trimethyl cyclopentene-4-propylene radical, and 1,2,3,5-tetramethyl cyclopentene-4-propylene radical.

98. (Amended) The process of claim 78, wherein the [composition] polymer is a ethylene/methyl acrylate/cyclohexenyl methyl acrylate terpolymer, a cyclohexenyl methyl acrylate/ethylene copolymer, a cyclohexenyl methyl methacrylate/styrene copolymer, a cyclohexenyl methyl acrylate homopolymer or a methyl acrylate/cyclohexenyl methyl acrylate copolymer.

Chevron Phillips Chemical Company LP

Polybutadiene Oxidation By-products



Chevron Phillips Chemical Company LP

EMCM Oxidation